

The Michigan Department of Environmental Quality Biennial Remedial Action Plan Update for the Saginaw River/Bay Area of Concern



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Purpose of the Biennial Remedial Action Plan Update

A Michigan Department of Environmental Quality (MDEQ) Biennial Remedial Action Plan (RAP) Update will be prepared at least every 2 years for each Area of Concern (AOC), and will be the primary tool for documenting and communicating progress to the public and agencies. These documents are meant to be brief, user-friendly updates on recent remedial actions and assessments in the AOC. They are prepared by the MDEQ in consultation with the Public Advisory Council (PAC) and the U.S. Environmental Protection Agency (USEPA). These biennial RAP updates will also be posted on the MDEQ AOC web site.

The biennial RAP update is one component of the MDEQ's process for tracking AOC restoration, removing Beneficial Use Impairments (BUIs), and ultimately delisting AOCs. These processes and relevant restoration criteria are described in more detail in the MDEQ's *Guidance for Delisting Michigan's Great Lakes Areas of Concern (Guidance)* (MDEQ, 2006).

The purpose of this Saginaw River/Bay biennial RAP update is to track progress in the AOC by providing an update on those remedial actions completed in recent years. This update will discuss BUI assessment results that are based on the readiness of a BUI removal and subsequent technical committee review and recommendations. Comprehensive background information is provided in the 1988 Saginaw River/Bay RAP document (Michigan Department of Natural Resources [MDNR], 1988), the draft 1995 RAP Update (MDNR, 1994), and the 2001 RAP Update (PSC [Public Sector Consultants], 2002).

How to Use this Document

For each of the 12 BUIs identified in the Saginaw River/Bay AOC, this biennial RAP update includes:

- A description of the significance of the BUI based on previous RAP documentation
- A summary of the restoration criteria for the BUI outlined in the *Guidance* document
- A brief summary of relevant remedial actions, if any, completed in recent years
- A brief summary of the technical committee's assessment activities and results, if any, completed in recent years
- A list of annotated references and studies that may be used by a technical committee when the MDEQ AOC coordinator, in consultation with the PAC, determines the BUI is ready for formal review of remedial actions and restoration according to the applicable criteria.

Introduction

Background

In 1987, amendments to the Great Lakes Water Quality Agreement (GLWQA) were adopted by the federal governments of the U.S. and Canada. Annex 2 of the amendments listed 14 BUIs which are caused by a detrimental change in the chemical, physical, or biological integrity of the Great Lakes system (International Joint Commission, 1988). The Annex directed the two countries to identify AOCs that did not meet the objectives of the GLWQA. The RAPs addressing the BUIs were to be prepared for all 43 AOCs identified, including the Saginaw River/Bay. The BUIs provided a tool for describing effects of the contamination, and a means for focusing remedial actions.

The Saginaw Bay area, located in the east central portion of Michigan's Lower Peninsula, is a southwestern extension of Lake Huron. The boundaries of the Saginaw River/Bay AOC includes the entire 22-mile length of the Saginaw River, beginning at the confluence of the Shiawassee and Titabawassee Rivers, and all of Saginaw Bay (1,143 square miles) out into its interface with open Lake Huron at an imaginary line drawn between Au Sable Point and Point Aux Barques (Figure 1).

The Saginaw River/Bay AOC was listed as an AOC due to contaminated sediments, fish consumption advisories, high bacteria, nutrient enrichment (e.g., phosphorus), sedimentation, degraded fisheries, and loss of significant recreational values (MDNR, 1988).

On May 31, 2006, the Saginaw River/Bay Public Advisory Council, known as the Partnership for the Saginaw Bay Watershed (the Partnership), held a meeting and voted to adopt the delisting targets included in the *Guidance* to evaluate the status of the AOC BUIs. The draft 1995 Saginaw River/Bay RAP identified 12 of the GLWQA's 14 beneficial uses as being impaired including: Restrictions on Fish and Wildlife Consumption, Tainting of Fish and Wildlife Flavor, Bird or Animal Deformities or Reproductive Problems, Degradation of Benthos, Restrictions on Dredging Activities, Eutrophication or Undesirable Algae, Restrictions on Drinking Water Consumption or Taste and Odor Problems, Beach Closing, Degradation of Aesthetics, Degradation of Phyto- or Zooplankton Populations, Degradation of Fish and Wildlife Populations, and Loss of Fish and Wildlife Habitat (MDNR, 1994). Table 1 is a matrix for tracking the progress of assessments and removal of these BUIs from the Saginaw River/Bay AOC.

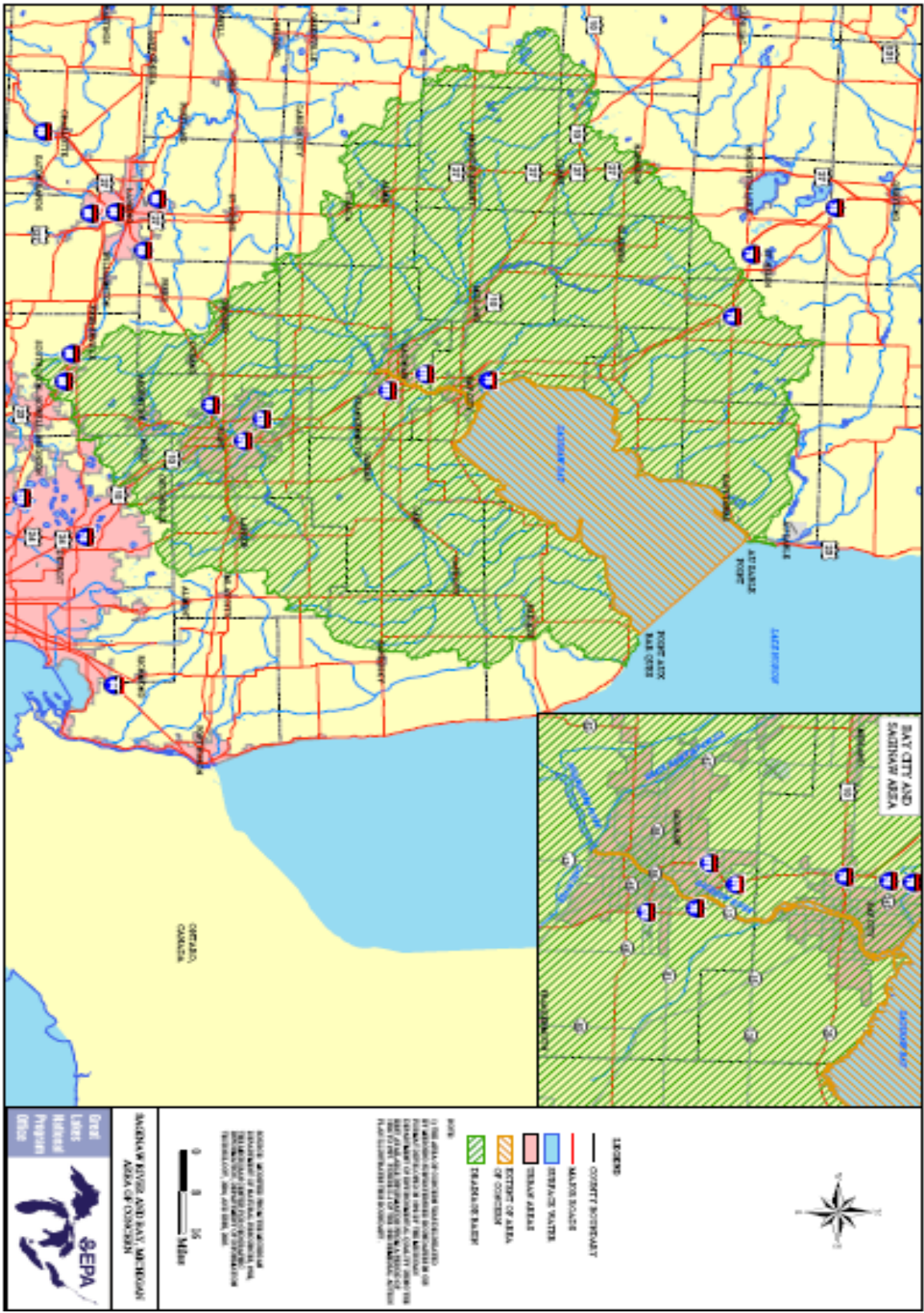


Figure 1. The Saginaw River/Bay Area of Concern.

Beneficial Use Impairment	Beneficial Use Remains Impaired	Assessment in Progress	BUI Removed
Restrictions on fish and wildlife consumption	x		
Tainting of fish and wildlife flavor		x	
Bird or animal deformities or reproductive problems	x		
Degradation of benthos	x		
Restrictions on dredging activities	x		
Eutrophication or undesirable algae	x		
Restrictions on drinking water consumption or taste and odor problems		x	
Beach closings	x		
Degradation of aesthetics	x		
Degradation of phyto- or zooplankton populations	x		
Degradation of fish and wildlife populations	x		
Loss of fish and wildlife habitat	x		

Restrictions on Fish and Wildlife Consumption

Significance in the Saginaw Area of Concern

As a result of the historical production and/or use of PCBs, dioxins, dichlorodiphenyltrichloroethane (DDT) and heavy metals in the Saginaw River/Bay AOC, consumption of fish has been identified as an impaired use in the AOC (MDNR, 1988). The Michigan Department of Community Health (MDCH), *Michigan Family Fish Consumption Guide*, recommends various consumption advisories for the entire length of the Saginaw River and all of the Saginaw Bay (MDCH, 2007a). The advisory for the bay also includes species that are listed for Lake Huron.

The MDEQ, USEPA, U.S. Army Corps of Engineers (USACE), and Dow Chemical studies of dioxin contamination in the Saginaw River and Bay strongly indicate that dioxin contamination from Tittabawassee River sediments are a current and active source of dioxin contamination to the Saginaw River and Saginaw Bay. In late 2007, the MDCH issued an Interim Fish Consumption Advisory for the Saginaw River. This action extended the advisory currently in effect for the Tittabawassee River to the entire length of the Saginaw River due to high levels of dioxins that were found in sediments in the middle of the Saginaw River, just off shore Wickes Park, immediately below the confluence with the Tittabawassee River.

Restoration Criteria

The Partnership has accepted the state's criteria for restoring this beneficial use. The fish consumption advisory in the Saginaw River/Bay AOC is more stringent than for Lake Huron, the associated Great Lake. This BUI will need to be assessed using either a comparison study or trend analysis.

Remedial Actions

Many pollution reduction regulations and programs have been instituted since the designation of the AOC. Some have been aimed at reducing pollution in general across the country. Others have been focused on the Saginaw River/Bay AOC specifically. All have served, directly or indirectly, to improve the water quality conditions in the AOC. Highlighted below are examples of remedial actions that have occurred since the 2001 RAP Update:

In 2006, the MDCH conducted a Saginaw Bay Watershed and City of Saginaw Fish Consumption Advisory Outreach project. The project resulted in:

- Three new fish/wild game consumption advisory brochures for the Saginaw Bay watershed.
- Three outreach events have been conducted in the city of Saginaw to low-income urban fishers that included the distribution of information about how to safely consume fish from the Saginaw River.
- A fish consumption patterns survey of people fishing in the Saginaw River, Saginaw Bay, Shiawassee/Bad River, and Tittabawassee River (MDCH, 2007b).

The findings of the project support the need for continued partnerships between MDCH and local community groups in the City of Saginaw to better inform people about the fish consumption advisory.

In 2006 and 2007, a detailed geomorphic dioxin distribution study was completed for the upper Tittabawassee River and middle Tittabawassee River. Over 8,000 soil and sediment samples were collected. In 2007, based on dioxin trigger levels (10,000 part per trillion [ppt] toxic equivalence concentration [TEQ]) and additional step-out delineation, interim response actions under USEPA's Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), commonly known as Superfund, Emergency Response commenced at three locations in the Tittabawassee River. The assessment of dioxin concentrations in the lower Tittabawassee River is to be completed in 2008.

In December 2007, a 1,600,000 ppt TEQ surficial sediment sample from the Upper Saginaw River triggered an USEPA CERCLA Emergency Response Action at Wickes Park. Between mid-December and early January, Dow Chemical's contractors removed approximately 625 cubic yards of sediment from the river. More detailed information on the Wickes Park project can be accessed at: <http://www.epa.gov/region5/sites/dowchemical/wickespark/polrep-wp05.htm>.

Sampling at the Sixth Street Turning Basin (approximately six miles downstream of the confluence of the Tittabawassee River and Shiawassee River) indicated that high levels of dioxin (up to 30,000 ppt TEQ) are present in the mobile sediment bed load of the Saginaw River. Under MDEQ's hazardous waste Operating License, which incorporates Resource Conservation and Recovery Act (RCRA) Corrective Action obligations, Dow Chemical is submitting a Remedial Investigation Work Plan for the Saginaw River and Saginaw Bay in April 2008. This contamination characterization is required as part of Dow Chemical Company's hazardous waste operating license that was issued in June of 2003.

Additional characterization of the Tittabawassee River, Saginaw River and Saginaw Bay is also anticipated to be conducted as part of the Natural Resource Damage Assessment (NRDA) process. The final response activities for the Tittabawassee River and Saginaw River will be identified and implemented as part of MDEQ's RCRA Corrective Action. For additional information on dioxin in the Saginaw River/Bay AOC access the MDEQ Dioxin Information webpage at: http://www.michigan.gov/deq/0,1607,7-135-3311_4109_9846_9847-43808--,00.html; or the USEPA's Tittabawassee/Saginaw River/Saginaw Bay Cleanup website at: <http://www.epa.gov/region5/sites/dowchemical/index.htm>

Assessment Activities and Results

This beneficial use is currently impaired. A technical committee will be convened when the MDEQ and the Partnership determine that this BUI is ready for a formal review and assessment. The technical committee will review the results of all remedial actions completed and other supporting documentation (see below) to provide a decision on whether or not to support a recommendation to formally remove this BUI.

Annotated References and Studies

Bohr, J. and J. Zbytowski. 2006. Michigan Fish Contaminant Monitoring Program: 2006 Annual Report. MDEQ-WB Report # MI/DEQ/WB-7/053. www.michigan.gov/deq/0,4561,7-135-3313_3681_3686_3728-32393--,00.html

The MDEQ's fixed station whole fish contaminant trend monitoring project was initiated to measure spatial and temporal trends of certain bioaccumulative contaminants.

MDCH. 2007a. Michigan Family Fish Consumption Guide: Important Facts to Know if You Eat Michigan Fish. www.michigan.gov/mdhhs/0,5885,7-339-71548_54783_54784_54785---,00.html

Certain kinds and sizes of fish from the Great Lakes, and some Michigan lakes and streams, contain levels of toxic chemicals that may be harmful if those fish are eaten too often. The MDCH advises caution about eating Michigan fish for the general population, women of childbearing age, and children under 15 years old.

MDCH. 2007b. Fish Consumption Survey of People Fishing and Harvesting Fish from the Saginaw Bay Watershed.

The objective of the survey was to determine the fish consumption patterns of fisherman in the Saginaw Bay watershed.

Tainting of Fish and Wildlife Flavor

Significance in the Saginaw River/Bay Area of Concern

According to the 1988 RAP, chemical odors and tastes associated with fish caught in the Tittabawassee River and the Saginaw River/Bay AOC were frequently reported from the 1940s through the 1970s (MDNR, 1988). Though the cause of the historic tainting episodes have been largely unknown, the potential sources were likely related to water quality contaminants resulting from discharges from municipalities and industry within the watershed into the AOC that are now required to meet National Pollutant Discharge Elimination System (NPDES) permit requirements. According to the draft 1995 and 2000 RAPs, the complaints of fish tainting have now all but disappeared in the Saginaw River/Bay AOC (MDNR, 1995 and PCS, 2000).

Restoration Criteria

The Partnership has accepted the state's criteria for restoring this beneficial use. This BUI will be considered restored if the MDNR or the MDEQ has not received more than three reports of fish tainting in the AOC for a period of three years; or if more than three reports have been made during the three-year period, an MDEQ-sanctioned taste test determines that the impairment no longer exists.

Remedial Actions

Many pollution reduction regulations and programs have been instituted since the designation of the AOC. Some have been aimed at reducing pollution in general across the country. Others have been focused on the Saginaw River/Bay AOC specifically. All have served, directly or indirectly, to improve the water quality conditions in the AOC. The significant source control and remedial actions that have occurred since the 2001 RAP Update are listed below under the Remedial Actions section of the Eutrophication BUI, and provide a weight of evidence that potential fish tainting sources have been addressed by current state and federal regulations and programs (PSC, 2007).

Assessment Results

In 2007 and on behalf of the Partnership, PSC sent letters to the MDNR and MDEQ requesting information on any reports of tainted or off-flavored fish made by the public in the past three years. PSC also sent letters to local health department, the MDCH, and also included an information piece in the Saginaw Bay Walleye Club's newsletter, which reaches approximately 300 members. The information piece requested information on angler's observation of fish tainting.

None of the agencies or members of the walleye club received or reported tainted or off-flavored fish in the past three years. These responses satisfy the requirements of *Guidance* criteria for delisting.

While the MDCH reported that it has not received any unsolicited reports of fish tainting from AOC residents, the agency had conducted a survey in 2005 and 2006 of fish consumption habits in the Saginaw watershed, and included a few questions regarding fish tainting (MCHD, 2007b). Twenty-eight of 460 respondents surveyed between 2005 and 2006 in the Saginaw River/Bay AOC replied that they had noticed “odd smells or tastes in fish” within the previous year. Descriptions of the “odd smells or tastes” varied widely. The majority of the comments were described as “bad,” “odd,” or “different.” To a lesser degree, interviewees described fish as tasting or smelling “chemical” and “fishy.”

While the MDEQ *Guidance* criteria did not require a comparison of the frequency of fish tainting reports in the AOC with a non-AOC water body, the MDCH fish consumption survey data collected made such a comparison possible. The MDCH survey responses for the Shiawassee River and the Bad River were combined and were considered as a non-AOC control area. These rivers were considered for the comparison because of their connectivity to the Saginaw River, and because these water bodies were not considered part of the historical fish tainting problems. Statistical analysis showed no significant difference between the percentages of respondents within the AOC and those in the control area reporting tainted fish.

Recently gathered information assessing the current status of this BUI, in addition to the remedial actions, source control programs, and other considerations described above, indicate that this beneficial use has been restored in the Saginaw Bay/River AOC. The removal process has commenced with the submission a removal recommendation document from the Partnership to the MDEQ (PSC, 2007). The AOC staff is currently in the process of scheduling a public meeting to solicit public comment in an effort to make a determination on whether or not to support the removal of this BUI.

Annotated References and Studies

Fetterolf, C. 1963. Fish Tainting Problems in Saginaw Bay, Winter of 1962-1963. Michigan Water Resources Commission.

Fetterolf, C. nd. Fish Off-Flavor Problems in Saginaw Bay, Lake Huron, with a Summary of Factors which Influence the Palatability of Fish.

Both reports provide a historic perspective on the sporadic complaints reported from commercial fisherman concerning tainted fish in Saginaw Bay in the early 1960s.

MDCH. 2007b. Fish Consumption Survey of People Fishing and Harvesting Fish from the Saginaw Bay Watershed.

The survey was conducted during the high fishing periods of the year between 2005 and 2006. The objective of the survey was to determine the fish consumption patterns of fisherman in the Saginaw Bay watershed. Twenty-four questions covered four topics including awareness about Michigan's fish consumption advisory, fish consumption patterns related to the water body the person was fishing on at the time of the interview, fish consumption patterns related to other sources (e.g., fish other local water bodies), and demographics.

MDNR. 1990. Results of a Fish Flavor Impairment Study Conducted Using Fish Taken from the Tittabawassee River, Midland County, Michigan, October 4, 1989. Report #MI/DNR/SWQ-89/161.

The Tittabawassee River has historically been considered a potential source of contaminants that have caused tainting of fish flavor in the AOC. A fish flavor impairment study was conducted on fish from the Tittabawassee River in response to complaints of poor tasting fish caught downstream of the Sanford dam. A panel of volunteers was convened to judge the taste of walleye which were caught in the river both upstream and downstream of the dam. No significant differences were observed by the panel between the reference fish and the upstream or downstream fish. Improvements in fish flavor demonstrated in the Tittabawassee provide an indication that pollution in the Tittabawassee River may no longer be contributing to fish tainting.

Michigan Water Resources Commission. 1965. Taste Test of Fish from Saginaw Bay, May 12, 1965 by Water Resources Commission Personnel.

During the spring of 1965 sporadic complaints of fish tainting were reported to the Water Resources Commission from the Au Gres area of Saginaw Bay. A tasting panel was convened to judge the flavor and smell of yellow perch collected from Saginaw Bay and a fish market (served as a control). Off flavor was detected in some of the fish taken from Saginaw Bay.

Bird or Animal Deformities or Reproductive Problems

Significance in the Saginaw River/Bay Area of Concern

The Saginaw River/Bay was listed as having this use impairment for bird and animal deformities based on adverse effects in gull, terns, and eagles. According to the 2000 RAP, the evidence that led to this designation included terns, herons, and eagles that were injured due to contaminants and linked to death (Caspian terns), malfunctions in reproduction (Caspian terns, common terns, bald eagles),

and physical deformations (black-crowned night herons, Caspian terns, common terns) (PSC, 2000).

According to 2000 RAP, the with the reduction in sources of persistent toxic contaminants such as PCBs, most of the fish-eating bird populations have recovered and populations of herring gulls, Caspian terns, black-crowned night herons, and double-crested cormorants have become re-established throughout Saginaw Bay (PSC, 2000). However, reproductive failures are believed to still occur in a small percentage of populations in local areas, especially at the Channel/Shelter Island Confined Disposal Facility (CDF). Evidence suggests that herring gulls, herons, and terns using this CDF for nesting may be exposed to contaminants inadequately contained at this site (PSC, 2000).

Restoration Criteria

The Partnership has accepted the state's criteria for restoring this beneficial use. According to the *Guidance*, restoration of this beneficial use will be demonstrated using one of two approaches. The approach taken will depend on the availability of data. The first approach evaluates restoration based on field observation data over a minimum of two successive monitoring cycles. The second approach will be applied where bird or other wildlife observational data are not available. This approach will use levels of contaminated fish tissue known to cause reproductive or developmental problems as an indicator of the likelihood deformities or reproductive problems may exist in the AOC.

Remedial Actions

Many pollution reduction regulations and programs have been instituted since the designation of the AOC. Some have been aimed at reducing pollution in general across the country. Others have been focused on the Saginaw River/Bay AOC specifically. All have served, directly or indirectly, to improve the water quality conditions in the AOC. The significant source control and remedial actions that have occurred since the 2001 RAP Update are listed below under the Remedial Actions section of the Eutrophication or Undesirable Algae BUI.

Assessment Results

This beneficial use is currently impaired. A technical committee will be convened when the MDEQ and the Partnership determine that this BUI is ready for a formal review and assessment. The technical committee will review the results of all remedial actions completed and other supporting documentation (see below) to provide a decision on whether or not to support a recommendation to formally remove this BUI.

Annotated References and Studies

Bowerman, W., T Kubiak, J. Holt, D. Evans, R. Eckstein, C. Sindelar, D. Best, and K. Kozie. 1994. Observed Abnormalities in Mandibles of Nestling Bald Eagles *Haliaeetus leucephalus*. Bulletin Environmental Contamination Toxicology, 53:450-457.

The researchers found that concentration of PCBs for some bald eagle nestlings are much higher than levels associated with healthy bald eagle populations. Some breeding areas in Saginaw River/Bay are also exhibit very low productivity and success rates.

Michigan Department of Environmental Quality. 2004. Michigan Wildlife Contamination Trend Monitoring. Year 2002 Annual Report. Nestling Bald Eagles. MI/DEQ/WD-04/024.

Michigan Department of Environmental Quality. 2006. Michigan Wildlife Contamination Trend Monitoring. Year 2003 Annual Report. Nestling Bald Eagles (Draft).

Since 1999, the MDEQ has funded researchers at Michigan State University (MSU) and Clemson University to measure contaminant levels in bald eagle blood and feathers. Bald eagle productivity is also monitored. Eaglets from selected nests have been monitored annually, while others have been sampled according to the MDEQ's five-year rotating watershed cycle. Samples are analyzed for PCBs, mercury, DDT, and a few other selected pesticides (Edly and Wuycheck, 2006).

The same researchers monitoring bald eagles are also assessing contaminant levels (PCBs, DDT, and mercury) in herring gull eggs. This project complements and expands existing herring gull egg monitoring conducted by the Canadian Wildlife Service. The data are used for trend assessment of near-shore areas of the Great Lakes (Edly and Wuycheck, 2006).

Grasman, K. and G. Fox. 2001. Associations Between Altered Immune Function and Organochlorine Contamination in Young Caspian Terns (*Sterna caspia*) from Lake Huron, 1997-1999. *Ecotoxicol.* 10(2):101-114.

This study confirmed that associations between organochlorines and suppressed T cell function and enhanced antibody production in young Caspian terns from the Great Lakes, first observed in the early 1990s, continued into the late 1990s. These associations were based on measurement of organochlorines in plasma of individuals and pooled egg samples. Between 1997 and 1999, immune function, hematological variables, and organochlorine contamination were measured in pre fledgling Caspian terns at two Lake Huron colonies: Channel Shelter Island CDF at the mouth of the Saginaw River in southern Saginaw Bay and Elm Island in the North Channel.

Weseloh, D., C. Perkarik, and S. DeSolla. 2006. Spatial Patterns and Rankings of Contaminant Concentrations in Herring Gull Eggs from 15 Sites in the

Great Lakes and Connecting Channels, 1998-2002. Environmental Monitoring Assessments. 113:265-284.

Mean values of eight contaminants in Herring Gull eggs were calculated for 15 Great Lakes sites for the 5 year period. The sites were ranked according to the concentrations of each of seven compounds relative to fish flesh criteria for the protection of piscivorous wildlife, and a single overall rank of contamination was calculated for each site.

Degradation of Benthos

Significance in the Saginaw River/Bay Area of Concern

The 1988 RAP defined the degradation of the benthos of Saginaw Bay as an impaired use because the benthic community structure in the bay is significantly degraded from that which occurs in unpolluted sites elsewhere in the Great Lakes (MNDR, 1988). The benthic communities in both the Saginaw River and Saginaw Bay are dominated by pollution tolerant forms such as the aquatic worms and midges (MDNR, 1995). Factors that have been linked to the changes in the benthic community include habitat loss, sedimentation, eutrophication, and contamination due to the discharge of toxic contaminants (PSC, 2000). Specifically, the mayfly *Hexagenia limbata*, historically abundant in Saginaw Bay and an important component of the fish forage base, is currently only rarely found in the bay. Researchers believe that high oxygen demand created by increased decomposition of organic debris in the sediments has decreased dissolved oxygen levels below that needed to support mayflies and other pollution intolerant species. The benthic community is also currently undergoing rapid change as a result of colonization by zebra mussels. It is unknown what impact this exotic species will have on the ecosystem.

Restoration Criteria

The Partnership has accepted the state's criteria for restoring this beneficial use. According to the *Guidance*, an assessment of the benthic community will be conducted by either MDEQ's Surface Water Assessment Section (SWAS) procedures for wadeable or non-wadeable streams (MDEQ, 2002); or, in cases where MDEQ procedures are not applicable and benthic degradation is caused by contaminated sediments, this beneficial use will be considered restored when all remedial actions for known contaminated sediment sites with degraded benthos are completed (except for minor repairs required during operation and maintenance) and monitored according to the approved plan for the site.

Remedial Actions

Many pollution reduction regulations and programs have been instituted since the designation of the AOC. Some have been aimed at reducing pollution in general across the country. Others have been focused on the Saginaw River/Bay AOC specifically. All have served, directly or indirectly, to improve the water quality conditions in the AOC. The significant source control and remedial actions that

have occurred since the 2001 RAP Update are listed below under the Remedial Actions section of the Eutrophication or Undesirable Algae BUI.

Assessment Activities and Results

This beneficial use is currently impaired. A technical committee will be convened when the MDEQ and the Partnership determine that this BUI is ready for a formal review and assessment. The technical committee will review the results of all remedial actions completed and other supporting documentation (see below) to provide a decision on whether or not to support a recommendation to formally remove this BUI.

Annotated References and Studies

Nalepa, T.F., D.L. Fanslow, M.B. Lansing, and G.A. Lang. 2003. Trends in the Benthic Macroinvertebrate Community of Saginaw Bay, Lake Huron, 1987 to 1996: Responses to Phosphorus Abatement and the Zebra Mussel, *Dreissena polymorpha*. *Journal of Great Lakes Research*. 29(1): 14-33

Trends in benthic macroinvertebrate populations were examined in inner and outer Saginaw Bay, Lake Huron, from 1987 to 1996. These years represent the time period after phosphorus abatement, but immediately before (1987 to 1990) and after (1991 to 1996) colonization of Saginaw Bay by the zebra mussels.

Restrictions on Dredging Activities

Significance in the Saginaw River/Bay Area of Concern

Historically, sediments dredged from parts of the navigation channel in the Saginaw River and Saginaw Bay require confined disposal because of elevated levels of pollutants, including PCBs, several metals (e.g., mercury), nutrients, and oil and grease (MDNR, 1995). This has resulted in operational and disposal restrictions being placed on dredging conducted in the Saginaw River/Bay AOC.

Restoration Criteria

The Partnership has accepted the state's criteria for restoring this beneficial use. According to the *Guidance*, this beneficial use will be considered restored when either there have been no restrictions on routine commercial or recreational navigational channel dredging by the USACE, based on the most recent dredging cycle; or, in cases where dredging restrictions exist, a comparison of sediment contaminant data from the commercial or recreational navigation channel (at the time of proposed dredging) in the AOC indicates that contaminant levels are not statistically different from other comparable, non-AOC commercial or recreational navigation channels.

Remedial Actions

Many pollution reduction regulations and programs have been instituted since the designation of the AOC. Some have been aimed at reducing pollution in general across the country. Others have been focused on the Saginaw River/Bay AOC specifically. All have served, directly or indirectly, to improve the water quality conditions in the AOC.

The USACE conducts pre-maintenance survey for metals, PCBs, and organic compounds every five years and sometimes more frequently, and dredges the Saginaw River navigational channel every year. Only the most critical portions of the Saginaw River navigation channel are dredged. The most recent maintenance dredging activities occurred in 2007, which included dredging in the lower Saginaw River and Saginaw Bay. The most recent pre-maintenance survey conducted in 2004 found non-detectable levels of PCBs and mercury, and detectable levels of dioxin in most samples. Additional metals were low and other organic compounds were non-detectable. An additional sampling effort was conducted in 2006 to further delineate the last mile of upper Saginaw River and found that all stations in the river had detectable levels of dioxin. The mercury levels were detectable, but less than 1.0 ppm (part per million), and PCBs were all non-detectable. The areas with the highest dioxin levels are located in the last one mile of federal channel, up to the Sixth Street turning basin. In 1999, 26 stations sampled on the Saginaw River and Saginaw Bay and had detectable levels of dioxin, detectable levels of mercury (but less than 1.0 ppm), and non-detectable levels of PCBs. The dredging in 2007 was performed by mechanical dredging, and no dredging restrictions were placed on the contract (P. Horner, personal communication, December 13, 2007).

Assessment Activities and Results

This beneficial use is currently impaired. A technical committee will be convened when the MDEQ and the Partnership determine that this BUI is ready for a formal review and assessment. The technical committee will review the results of all remedial actions completed and other supporting documentation to provide a decision on whether or not to support a recommendation to formally remove this BUI.

Annotated References and Studies

Great Lakes Dredging Team. 1999. Decision Making Process for Dredged Material Management. Draft Final, October 13, 1998, Amendment #1, January 18, 1999.

This document describes how to manage the dredged material, management options, treatment technologies available, the technical evaluation process, and regulatory information.

Eutrophication or Undesirable Algae

Significance in the Saginaw River/Bay Area of Concern

According to the 1988 RAP, various biota populations in the Saginaw River/Bay AOC have been negatively impacted by degraded water quality conditions (MDNR, 1988). Nuisance organic “muck” debris, composed mainly of *Cladophora* (a benthic algae), continues to wash ashore along Saginaw Bay (Saginaw Bay Science Committee Pathogen Work Group, 2007). These conditions are thought to be caused, in part, by the cultural eutrophication of Saginaw Bay. In addition, the phytoplankton community has been impacted by the colonization of Saginaw Bay by zebra mussels. Zebra mussels are filter feeders that remove much of the plankton biomass from the water. It is suspected that some plankton species may be more susceptible to removal from the water column than others, resulting in community population shifts that favor nuisance species like *Cladophora*. Shallow embayments throughout the Great Lakes region, including Saginaw Bay, have undergone this type of fundamental transformation to a benthic-dominated environment, where processes unrelated to anthropogenic influences have been found to promote the growth of algal blooms.

According to the 2006 Clean Water Act *Water Quality and Pollution Control in Michigan: Section 303(d) and 305(b) Integrated Report* (Integrated Report), Saginaw Bay nutrient and chlorophyll *a* data from 1993 through 2003 reflect a mesotrophic to eutrophic condition (Edly and Wuycheck, 2006). Total phosphorus remains constant and continues to be above the target of 15 micrograms per liter (ug/l) (PSC, 2001). Chlorophyll *a* has traditionally been used as an indicator of phytoplankton production in natural waters. Chlorophyll *a* concentrations also remain constant and often exceed 10ug/l, the accepted threshold for eutrophic conditions. It is believed that, among other potential sources, problems remain with non-point sources of phosphorus in many of the subwatersheds draining into Saginaw Bay. Estimates indicate that 80 to 90 percent of phosphorus now entering the bay is coming from non-point sources (PSC, 2000).

Restoration Criteria

The Partnership has accepted the state’s criteria for restoring this beneficial use. According to the *Guidance*, this beneficial use will be considered restored when there are no waterbodies within the AOC included on the list of impaired waters due to nutrients or excessive algal growths in the most recent Integrated Report, which is submitted to USEPA every two years. In addition, the MDEQ is in the process of developing nutrient criteria for state surface waters which will be adopted into Michigan’s WQS. The MDEQ will evaluate restoration of this BUI consistent with the nutrient criteria once the nutrient criteria are approved by the USEPA and adopted into rule.

Remedial Actions

Many pollution reduction regulations and programs have been instituted since the designation of the AOC. Some have been aimed at reducing pollution in general across the country. Others have been focused on the Saginaw River/Bay AOC specifically. All have served, directly or indirectly, to improve the water quality conditions in the AOC. The significant source control and remedial actions that have occurred since the 2001 RAP Update are highlighted below.

- Reductions in phosphorus loadings to the Great Lakes through point and nonpoint source controls have substantially contributed to improved water quality. The National Pollutant Discharge Elimination System (NPDES) permitting program, initiated by the Federal Water Pollution Control Act amendments of 1972, has been the principal mechanism for substantially reducing point source phosphorus loadings to Michigan's surface waters. Improvements in Michigan's water quality are attributable, in part, to nutrient limits applied at municipal sewage treatment plants and industrial discharges. According to the 2001 RAP, communities in the Saginaw Bay watershed have spent approximately \$700 million since 1972 to improve wastewater treatment facilities. These improvements have significantly reduced the amount of nutrients entering the Saginaw River/Bay AOC. Currently, all municipalities along the Saginaw River are evaluating their treatment of CSOs to determine whether they are meeting the design standards established in their NPDES Permits.
- The Saginaw Bay Science Committee Pathogen Work Group was formed to address potential human health risks associated with the accumulation of the algal material on the shores of Saginaw Bay. The science committee was charged to address issues and needs regarding *Escherichia coli* (*E. coli*), pathogen risks, and to specifically address citizen concerns on the presence of *E. coli* in detritus material in the Saginaw Bay area. The findings of the Science Committee were reported in the *Saginaw Bay Coastal Initiative: Potential Public Health Risks Associated with Pathogens in Detritus Material ("Muck") in Saginaw Bay*.
- In addition, non-point source remedial efforts have been ongoing in the upper Saginaw Bay watershed to address nutrient loadings. The Saginaw watershed is one of three priority watersheds under the Michigan's Conservation Reserve Enhancement Program (CREP). Implemented in 2001, the CREP is a 15-year program to reduce sediment, phosphorus, and nitrogen loadings entering the surface water of the Saginaw Bay, Macatawa River, and River Raisin watersheds. Through September 2007, the Saginaw Bay watershed has had the largest number of acres enrolled (47,976) in the program, and the highest percentage (79%) of all the CREP implementation sites. All 22 counties in the Saginaw Bay watershed have implemented CREP practices. The counties in the Saginaw Bay watershed with the most acreage enrolled in the program include Saginaw (9,369), Huron (8,337), Tuscola (7,196), and Arenac (5,036). The CREP program has installed over

29,000 acres of filter strips and restored over 14,000 acres of wetlands in the Saginaw Bay Watershed.

- The MDEQ has worked with a contractor to model the runoff at 10 representative CREP filter strip sites to determine the quantity of sediment and phosphorus that is controlled or prevented from running off into surface water by the CREP practices. Extrapolating the modeling results from these 10 sites to the level of implementation as of May 31, 2007, the MDEQ estimates that for the Saginaw Bay Watershed the sediment controlled is about 26,200 – 32,800 tons per year and the phosphorus controlled is about 72,500 – 83,900 pounds per year (Suppnick and Endicott, 2007).
- The MDEQ is also managing a Clean Michigan Initiative grant to develop a computer system that will eventually record the exact location of all CREP practices in a Geographic Information Systems (GIS) that is coupled with the drainage network.
- In June 2006, the MDEQ Director Chester requested the participation of a wide range of stakeholders on the MDEQ's Phosphorus Policy Advisory Committee. The charge to the Advisory Committee was to identify the major source categories of phosphorus loadings to Michigan's surface waters and compile the voluntary and regulatory management approaches that are being or could be used to control phosphorus. The Advisory Committee's findings were reported in *Phosphorus Policy Advisory Committee: Final Report* (PSC, 2007). These findings will augment the Saginaw Bay Phosphorus Reduction Strategy, in place since 1987, and will lead to further improvements in the phosphorous load in the Saginaw Bay.
- The Saginaw Bay Coastal Initiative (SBCI) was launched in August, 2006 to coordinate regional efforts to support innovative approaches for expanding local tourism and economic development, while enhancing resource protection and improving the quality of the environment within the Saginaw Bay area. Significant activities have taken place under the SBCI. Below are examples of some the projects that have been or are currently being implemented to address water quality issues. More information on the Initiative can be accessed at:
http://www.michigan.gov/deq/0,1607,7-135-7251_30353_42900---,00.html
- MDEQ district staff are currently overseeing MDEQ funded watershed projects on the Pinnebog River (Huron County), Sebewaing River (Huron County), Coldwater River (Isabella County), Cedar River (Gladwin County), and Sturgeon Creek (Midland County). These projects involve the identification of pollution sources, development of a watershed management plan, and implementation of corrective measures.

Assessment Activities and Results

This beneficial use is currently impaired. A technical committee will be convened when the MDEQ and the Partnership determine that this BUI is ready for a formal review and assessment. The technical committee will review the results of all remedial actions completed and other supporting documentation (below) to

provide a decision on whether or not to support a recommendation to formally remove this BUI.

Annotated References and Studies

Aiello, C. 2008. Michigan Water Chemistry Monitoring: Great Lakes Tributaries 1998-2005 Report. Michigan Department of Environmental Quality, Water Division. Report #MI/DEQ/WB-08/014.

Great Lakes Environmental Center. 2007. Water Quality Monitoring of Saginaw and Grand Traverse Bays: 2005 Annual Data Report. Report # MI/DEQ/WB-07/054.

Great Lakes Environmental Center. 2006. Water Quality Monitoring of Saginaw and Grand Traverse Bays. Report # MI/DEQ/WB-06/096.

The Water Chemistry Monitoring Project allows for the calculation of contaminant loadings from key Michigan tributaries. The key goals of this project are to: 1) assess the current status and condition of individual waterbodies and determine whether standards are being met, 2) measure temporal and spatial trends, 3) to detect new and emerging water quality problems, and 4) provide data to support MDEQ water quality programs and evaluate their effectiveness. Water chemistry reports are available at: http://www.michigan.gov/deq/0,1607,7-135-3313_3686_3728-32361--,00.html

MDEQ, Michigan Department of Agriculture, U.S. Department of Agriculture - Agricultural Stabilization and Conservation Service, and U.S. Department of Agriculture - Soil Conservation Service. 1991. State of Michigan Phosphorus Reduction Strategy for the Michigan Portion of Lake Erie and Saginaw Bay: Program Update.

The report updates Michigan's Phosphorus Reduction Strategy dated 1985. It identifies the progress that has been made between 1985 and 1991 in meeting the phosphorus reduction goals established in Annex 3 of the GLWQA.

PSC. 2007. Phosphorous Policy Advisory Committee: Final Report.

The charge to the Advisory Committee was to identify the major source categories of phosphorus loadings to Michigan's surface waters, and for each of these categories, to review and compile the voluntary and regulatory management approaches that are being or could be used to control phosphorus. Based on that review, the Advisory Committee developed findings and recommendations to help advance phosphorus management strategies protective of Michigan's surface waters, taking into consideration effectiveness, costs of implementation, feasibility, and the potential reductions associated with the various phosphorus control options.

Saginaw Bay Science Committee Pathogen Work Group. 2007. Saginaw Bay Coastal Initiative: Potential Public Health Risks Associated with Pathogens in Detritus Material (“Muck”) in Saginaw Bay.

To address this issue of excessive algal growth, detritus or “muck” covering the shoreline in parts of the Great Lakes, a science committee was formed as part of the SBCI to address potential human health risks associated with the accumulation of the algal material on the shores of Saginaw Bay. The science committee was charged with addressing issues and needs regarding *E. coli*, pathogen risks, and to specifically address citizen concerns on the presence of *E. coli* in the “muck”.

Suppnick, J. and D. Endicott. 2007. Conservation Reserve Enhancement Program Vegetative Filter Strip Effectiveness Modeling. Report #MI/DEQ/WB-07/118.

Suppnick, J. and J. Saxton. 2006. Conservation Reserve Enhancement Program 2006 Annual Water Quality Monitoring Report. #MI/DEQ/WB-06/109.

Suppnick, J. and GLEC. 2005. Conservation Reserve Enhancement Program 2005 Annual Water Quality Monitoring Report. Report #MI/DEQ/WB-05/122.

Suppnick, J. and GLEC. 2004. Conservation Reserve Enhancement Program 2004 Annual Water Quality Monitoring Report. Report #MI/DEQ/WB-04/085.

Suppnick, J. and GLEC. 2003. Conservation Reserve Enhancement Program 2003 Annual Water Quality Monitoring Report. Report #MI/DEQ/WB-03/118.

The MDEQ works closely with the Michigan Department of Agriculture to implement the CREP, a federal-state-local conservation partnership designed to reduce significant environmental effects related to agriculture. The CREP is being implemented in three critical watersheds (Saginaw Bay, Macatawa River, and River Raisin) that have intense agricultural land use. The objectives of the program are to improve and protect water quality and to promote and enhance wildlife habitat by providing incentives to Michigan citizens for implementing conservation practices for a period of 15 years (Edly and Wuycheck, 2006).

Restrictions on Drinking Water Consumption or Taste and Odor Problems

Significance in the Saginaw River/Bay of Concern

The 1988 RAP states that taste and odor in municipal water supplies drawn from Saginaw Bay was one of the principal water quality issues for Saginaw Bay (MDNR, 1988). According to the 2001 RAP, the drinking water use impairment was originally identified primarily due to significant taste and odor problems

during the 1970s that were linked to excessive blue-green algal (i.e., cyanobacteria) blooms, which had caused some of the drinking water intakes in the bay to exceed federal threshold odor standards (PSC, 2002). The 1994 RAP also lists this BUI as impaired because drinking water drawn from inner Saginaw Bay (i.e., Bay City water supply) must undergo ozone treatment to remove objectionable taste and odor (MDNR, 1994).

Restoration Criteria

According to the *Guidance*, the restoration criteria requires that monitoring data for two years indicates that public drinking water supplies meet the current and most stringent human health standards, objectives, or guidelines (at the point of distribution into the water system) for levels of disease-causing organisms, hazardous or toxic chemicals, or radioactive substances; and treatment needed to make raw water potable and palatable does not exceed standard methods in those supplies.

Remedial Actions

Many pollution reduction regulations and programs have been instituted since the designation of the AOC. Some have been aimed at reducing pollution in general across the country. Others have been focused on the Saginaw River/Bay AOC specifically. All have served, directly or indirectly, to improve the water quality conditions in the AOC. The significant source control and remedial actions that have occurred since the 2001 RAP Update are highlighted below.

In 1979, the city of Bay City built a water treatment facility that featured an ozonation treatment process, which destroys most bacterial, viruses, algae, and organic compounds that can cause taste and odor problems. The ozone treatment is utilized on a continuous basis to minimize taste and odor in the water supply (MDNR, 1994).

In 1989, the village of Caseville constructed a water intake buried below the sediment surface in Saginaw Bay (MDNR, 1994). The major benefit to using this system is that raw water from Saginaw Bay is prefiltered through the sediment prior to entering the intake.

The inner region of Saginaw Bay, specifically the Bay City drinking water supply, is presently listed in the 2006 Integrated Report (Edly and Wuycheck, 2006) as “impaired” due to taste and odor problems with drinking water intakes and elevated nutrients (i.e., phosphorus). Specifically, the inner region of Saginaw Bay is listed in Category 4b, which means that the impairment is being addressed through an approved pollutant control mechanism other than a TMDL. The control mechanism in place to address elevated phosphorus levels in the inner region of Saginaw Bay is the Saginaw Bay Phosphorus Reduction Strategy of 1985.

The Saginaw Bay Phosphorus Reduction Strategy was developed in response to the 1985 Phosphorus Reduction Supplement to Annex 3 of the 1978 GLWQA. The target phosphorus load of 440 metric tons per year was established to reduce taste and odor in the Saginaw Bay drinking water supplies. The recommended criterion of 15 ug/l as a spring area-wide mean total phosphorus concentration was thought to represent the estimated “in bay” concentration when the 440 tons per year target load has been met. Although this goal has not yet been achieved, phosphorus reductions in combination with actions at the water treatment plants have been sufficient to eliminate drinking water taste and odor problems at the point of distribution. The remaining issues related to nutrient enrichment will continue to be addressed by the implementation of the Saginaw Bay Phosphorus Reduction Strategy and will be handled for this RAP under the Eutrophication or Undesirable Algae BUI listing. See the Remedial Actions section under the Eutrophication or Undesirable Algae BUI above for other remedial actions that have helped to restore this use impairment.

Assessment Activities and Results

The 2005 and 2006 calendar year water quality reports for the five municipal water supplies that draw water from Saginaw Bay were reviewed (see annotated references below). These reports provide the annual water quality testing data results based on all state and federal water quality standards, and are sent to the citizens served by the municipal drinking water facilities. These reports indicated that all of the Saginaw Bay public water supplies meet the MDEQ and the USEPA’s current and most stringent drinking water regulatory requirements for levels of disease-causing organisms, hazardous or toxic chemicals (e.g., PCBs and dioxins), and radioactive substances at the point of distribution. In addition, no public drinking water intake in Saginaw Bay has ever been closed due to contamination.

Comments were also solicited regarding the redesignation of this BUI from an ad hoc Technical Committee comprised of the five municipal water supply supervisors servicing Saginaw Bay residents, the MDEQ district and Lansing staff, and other stakeholders. The Technical Committee determined that treatment needed to make raw water potable and palatable in Saginaw Bay drinking water supplies does not exceed standard methods. Specifically, the use of ozonation in the Bay City drinking water supply is considered a standard method for treating drinking water. Though not yet widely used in the United States (mainly due to cost), ozone is considered an acceptable treatment method that is used in the states and throughout the world.

Ozone currently being utilized to treat surface water for drinking at several municipal drinking water facilities in Michigan, including: Bay City, Ann Arbor, Monroe, Frenchtown Township, and Detroit (Personal communication, Richard Benzie, July 17, 2006). Ozone is considered an acceptable, alternate means of disinfection, which is an integral component of surface water treatment under both state and federal rules.

A public meeting was also held on June 13, 2007, to discuss this recommendation with the citizens that are serviced by the five municipal drinking water facilities in the AOC. The community expressed their support for recommending the removal of this BUI. Based on the state's restoration criteria outlined above, this BUI can be considered restored. On January 3, 2008, the MDEQ sent the removal recommendation documentation to the USEPA, Great Lakes National Program Office for consideration.

Annotated References and Studies

Caseville Water Treatment Plant. 2007. *Water Supply Serial #1190*. Volume 9, Issue 1.

Caseville Water Treatment Plant. 2006. *Water Supply Serial #1190*. Volume 8, Issue 1.

City of Bay City Municipal Water Treatment Plant. 2007. *City of Bay City Municipal Water Treatment Plant: 2006 Water Quality Report*. Retrieved August 6, 2007, from <http://www.baycitymi.org/Utilities/Water/WaterReport.pdf>

City of Bay City Municipal Water Treatment Plant. 2006. *City of Bay City Municipal Water Treatment Plant: 2005 Water Quality Report*. Retrieved July 31, 2006, from <http://www.baycitymi.org/waterreport.htm>

City of Midland, Utilities Department, Water Division. 2006. *2005 Drinking Water Quality Report*.

City of Midland, Utilities Department, Water Division. 2005. *2004 Drinking Water Quality Report*.

Huron Regional Water Authority. 2007. *City of Bad Axe 2006 Water Quality Report*.

Huron Regional Water Authority. 2005. *2005 Water Quality Report for Port Austin Area Sewer and Water Authority*.

Huron Shore Regional Utility Authority. 2007. *Your Annual Drinking Water Quality Report for City of East Tawas*. Retrieved August 6, 2007, from <http://my.voyager.net/~easttawas/>

Huron Shore Regional Utility Authority. 2006. *Your Annual Drinking Water Quality Report for City of East Tawas*. Retrieved July 31, 2006, from <http://www.easttawas.com/>

Saginaw Water Treatment Plant. 2007. *Water Quality: Drinking Water Quality Report for 2006*. Retrieved August 6, 2007, from <http://www.saginaw-mi.com/Profiles/saginawregion2006.pdf>

Saginaw Water Treatment Plant. 2006. *Water Quality: Drinking Water Quality Report for 2005*.

Beach Closings

Significance in the Saginaw River/Bay of Concern

According to the 1995 RAP, public advisories are periodically issued following storm events by local health departments warning against body contact with the Saginaw River and Saginaw Bay because of elevated levels of pathogens (*E. coli*) resulting from combined sewer overflows. Advisories have also been issued at the Bay City State Park beach because of large amounts of organic debris or “muck” both on shore and in the nearshore zone (MDNR, 1995). More recent, the detection of fecal indicators, including *E. coli*, in the “muck” has resulted in public concerns related to the potential human health implications of contact with the debris (Saginaw Bay Science Committee Pathogen Work Group, 2007).

Restoration Criteria

The Partnership has accepted the state’s criteria for restoring this beneficial use. The *Guidance* criteria for this BUI is currently being revised. The proposed criteria revision outlines a three tiered approach. The first tier requires that no waterbodies within the AOC are included on the 303(d) list of impaired waters due to contamination with pathogens in the most recent Integrated Report. If the waterbody is listed due to the presence of CSOs, or are impacted by upstream CSOs, the second criteria states that this BUI will be considered restored when updated information reveals that the CSOs have been eliminated or are being treated. Or, In cases where CSOs still exist and significant progress has been made towards their elimination or treatment, the third tier states that this BUI will be considered restored when monitoring in the AOC during the recreation period demonstrate that *E. coli* concentrations are below a 30-day geometric mean of 130 counts per 100 ml; at least 90% of sample results are below the daily geometric mean limits of 300 counts *E. coli* per 100 ml; no more than 1 of the sample results exceed the partial-body contact WQS of 1,000 counts *E. coli* per 100 ml based on a daily geometric mean; and MDEQ-approved plans in a NPDES permit are in place for addressing any remaining CSOs that are causing the use impairment and the implementation plan is on schedule.

Remedial Actions

Many pollution reduction regulations and programs have been instituted since the designation of the AOC. Some have been aimed at reducing pollution in general across the country. Others have been focused on the Saginaw River/Bay AOC specifically. All have served, directly or indirectly, to improve the water quality conditions in the AOC. The significant source control and remedial actions that have occurred since the 2001 RAP Update to address the pathogen sources within the Saginaw River/Bay AOC are listed below. Also, see above the Eutrophication or Undesirable Algae BUI Remedial Action section for projects that address “muck” issues and point source controls.

- A special program was developed to assist the public to report on any water related diseases. The WaterWatch website and instructions were made public through various newspapers, TV, radio outlets, and health department outreach. The website was active from May 2nd through October 1st, 2007. The intent of WaterWatch was to increase public health surveillance for waterborne diseases, both sporadic cases and potential outbreak situations (Saginaw Bay Science Committee Pathogen Work Group, 2007).
- The MDEQ district staff are currently working with Bay County, Saginaw County, Bay City, the city of Saginaw, and associated townships to implement stormwater control programs along the Saginaw and Kawkawlin Rivers through their NPDES Phase II permits. The MDEQ grants have been awarded to the storm water authorities in Saginaw and Bay Counties to identify and correct illicit discharges to their storm sewer systems. In addition, all municipalities along the Saginaw River are evaluating their treatment of CSOs to determine if the design standards established in their NPDES permits are being met.
- Sanitary surveys are completed by MDEQ district staff to detect and/or confirm the discharge of raw or inadequately treated sewage from on-site septic systems in a community to waters of the state. These community-wide surveys are conducted in conjunction with the local health department sanitarians. Between 1990 and August 2006, 14 sanitary surveys have been conducted in the Saginaw Bay area. In 2007, MDEQ staff conducted several sanitary surveys focusing on areas near the Village of Sanford, and in Caseville Township, and in areas along the Kawkawlin River.
- Also in 2007, the MDEQ worked with the Bay County Health Department and the Central Michigan District Health Department in Arenac County to implement beach sanitary surveys with funding from the USEPA. Beach sanitary surveys used simple field measurements and observations taken at the time of the water sampling in conjunction with sample results to help identify potential sources of *E. coli*. Results will be available later in 2008.

Assessment Activities and Results

This beneficial use is currently impaired. A technical committee will be convened when the MDEQ and the Partnership determine that this BUI is ready for a formal review and assessment. The technical committee will review the results of all remedial actions completed and other supporting documentation (see below) to provide a decision on whether or not to support a recommendation to formally remove this BUI.

Annotated References and Studies

MDEQ's beach website: <http://www.deq.state.mi.us/beach/public/default.aspx>

The MDEQ awards grants each year to local health departments to monitor *E. coli* levels at Great Lakes and inland beaches. County health departments use the results to assess whether the total body contact recreation designated use is being attained and whether beach closings

are necessary. Results are reported in annual beach monitoring reports and are posted on the MDEQ's beach website above (Edly and Wuycheck, 2006).

CSO & SSO Discharge website: http://www.deq.state.mi.us/csosso/find_event.asp

Facilities are required to report that a CSO and SSO discharge event occurred within 24 hours of the initial discharge. Later, after the event ends, a written report is submitted which contains additional information including volume of the discharge, and the start/end date and time. This information is posted on the above website.

Saginaw Bay Science Committee Pathogen Work Group. 2007. Saginaw Bay Coastal Initiative: Potential Public Health Risks Associated with Pathogens in Detritus Material ("Muck") in Saginaw Bay.

To address this issue of excessive algal growth, detritus or "muck" covering the shoreline in parts of the Great Lakes, a science committee was formed as part of the SBCI to address potential human health risks associated with the accumulation of the algal material on the shores of Saginaw Bay. The science committee was charged with addressing issues and needs regarding *E. coli*, pathogen risks, and to specifically address citizen concerns on the presence of *E. coli* in the "muck".

Degradation of Aesthetics

Significance in the Saginaw River/Bay Area of Concern

Similar to the Eutrophication or Undesirable Algae use impairment, increased biological productivity in Saginaw Bay resulted in an increase in the organic debris or "muck" washing up on the shoreline of Saginaw Bay. The debris consists of decomposing algae, aquatic plants, and small invertebrate animals. The smell and unsightliness of this beach debris prompted citizen complaints and concern about pollution entering the bay. Because of these complaints, aesthetics was listed as a use impairment for Saginaw Bay (MDNR, 1995).

Restoration Criteria

The Partnership has accepted the state's criteria for restoring this beneficial use. The *Guidance* criteria requires that monitoring data be collected for two successive monitoring cycles to determine whether or not the water bodies in the AOC exhibit persistent, high levels of the following "unnatural physical properties" (as defined by Rule 323.1050 of the Michigan WQS) in quantities which interfere with the state's designated uses for surface waters:

- turbidity
- color
- oil films
- floating solids
- foams
- settleable solids
- suspended solids
- deposits

Remedial Actions

Many pollution reduction regulations and programs have been instituted since the designation of the AOC. Some have been aimed at reducing pollution in general across the country. Others have been focused on the Saginaw River/Bay AOC specifically. All have served, directly or indirectly, to improve the water quality conditions in the AOC. The significant source control and remedial actions that have occurred since the 2001 RAP Update are listed above under the Remedial Actions section of the Eutrophication or Undesirable Algae BUI.

Assessment Activities and Results

This beneficial use is currently impaired. A technical committee will be convened when the MDEQ and the Partnership determine that this BUI is ready for a formal review and assessment. The technical committee will review the results of all remedial actions completed and other supporting documentation (see below) to provide a decision on whether or not to support a recommendation to formally remove this BUI.

Annotated References and Studies

Great Lakes Environmental Center. 2007. Water Quality Monitoring of Saginaw and Grand Traverse Bays: 2005 Annual Data Report. Report # MI/DEQ/WB-07/054.

Great Lakes Environmental Center. 2006. Water Quality Monitoring of Saginaw and Grand Traverse Bays. Report # MI/DEQ/WB-06/096.

The Water Chemistry Monitoring Project allows for the calculation of contaminant loadings from key Michigan tributaries. The key goals of this project are to: 1) assess the current status and condition of individual waterbodies and determine whether standards are being met, 2) measure temporal and spatial trends, 3) to detect new and emerging water quality problems, and 4) provide data to support MDEQ water quality programs and evaluate their effectiveness. Water chemistry reports are available at: http://www.michigan.gov/deq/0,1607,7-135-3313_3686_3728-32361--,00.html

PSC. 2007. Phosphorous Policy Advisory Committee: Final Report.

The charge to the Advisory Committee was to identify the major source categories of phosphorus loadings to Michigan's surface waters, and for each of these categories, to review and compile the voluntary and regulatory management approaches that are being or could be used to control phosphorus. Based on that review, the Advisory Committee

developed findings and recommendations to help advance phosphorus management strategies protective of Michigan's surface waters, taking into consideration effectiveness, costs of implementation, feasibility, and the potential reductions associated with the various phosphorus control options.

Saginaw Bay Science Committee Pathogen Work Group. 2007. Saginaw Bay Coastal Initiative: Potential Public Health Risks Associated with Pathogens in Detritus Material ("Muck") in Saginaw Bay.

To address this issue of excessive algal growth, detritus or "muck" covering the shoreline in parts of the Great Lakes, a science committee was formed as part of the SBCI to address potential human health risks associated with the accumulation of the algal material on the shores of Saginaw Bay. The science committee was charged with addressing issues and needs regarding *E. coli*, pathogen risks, and to specifically address citizen concerns on the presence of *E. coli* in the "muck".

Degradation of Phyto- or Zooplankton Populations

Significance in the Saginaw River/Bay Area of Concern

The lack of zooplankton grazing in Saginaw Bay was believed to be due, in part, to a greater abundance of large, unpalatable filamentous blue-green and green algae in Saginaw Bay (MNDR, 1988). Surveys conducted in the 1970s and early 1980s found that in certain areas of Saginaw Bay the phytoplankton community was composed of excessive levels of algal species, particularly *Cladophora*. These nuisance algal conditions were believed to be caused by the cultural eutrophication of Saginaw Bay, which was brought about by excessive nutrient loading. Phosphorus appeared to be the key factor responsible for excessive growth of *Cladophora*, and phosphorus abatement was seen as the most effective method of solving the problem. A decline in the abundance of *Cladophora* and other nuisance algae was observed in the 1980s following the implementation of regulations to remove phosphorus from detergents, improve phosphorus removal by sewage treatment plants, and land use practices.

However, since the 1990s the phyto- and zooplankton community in Saginaw Bay has remained impaired due to the colonization of zebra mussels in 1991. Zebra mussels are filter feeders that remove much of the plankton biomass from the water. It is suspected that some plankton species may be more susceptible to removal from the water column than others, resulting in community population shifts that favor less susceptible species like *Cladophora*.

In addition, it is believed that zebra mussels are out-competing *Diporeia*, a native shrimp-like crustacean, for phytoplankton. *Diporeia* feed on plankton at the bottom bay and then migrate up into the water column at night where they become food for fish such as alewives, which in turn become forage for other

predators (e.g., whitefish). The disappearance of *Diporeia* has altered the food web and disrupted the Saginaw Bay fisheries.

Restoration Criteria

The Partnership has accepted the state's criteria for restoring this beneficial use. Because this BUI was originally designated only in Saginaw River/Bay AOC due to hyper eutrophication, the statewide restoration criteria for this BUI is the same as the criteria for Eutrophication or Undesirable Algae. According to the *Guidance*, this beneficial use will be considered restored when there are no waterbodies within the AOC included on the list of impaired waters due to nutrients or excessive algal growths in the most recent Integrated Report, which is submitted to USEPA every two years.

Remedial Actions

Many pollution reduction regulations and programs have been instituted since the designation of the AOC. Some have been aimed at reducing pollution in general across the country. Others have been focused on the Saginaw River/Bay AOC specifically. All have served, directly or indirectly, to improve the water quality conditions in the AOC. The significant source control and remedial actions that have occurred since the 2001 RAP Update are listed above under the Remedial Actions section of the Eutrophication or Undesirable Algae BUI.

Assessment Activities and Results

This beneficial use is currently impaired. A technical committee will be convened when the MDEQ and the Partnership determine that this BUI is ready for a formal review and assessment. The technical committee will review the results of all remedial actions completed and other supporting documentation (see below) to provide a decision on whether or not to support a recommendation to formally remove this BUI.

Annotated References and Studies

Bridgeman, T.B., G.L. Fahnenstiel, G.A. Lang, and T.F. Nalepa. 1995. Zooplankton grazing during the zebra mussel (*Dreissena polymorpha*) colonization of Saginaw Bay, Lake Huron. *Journal of Great Lakes Research* 21(4):567-573.
<http://www.glerl.noaa.gov/pubs/fulltext/1995/19950016.pdf>

As part of a large-scale monitoring program in Saginaw Bay, zooplankton abundance and biomass estimates were also recorded during May through August of 1991 and 1992. Weight-specific zooplankton filtering rates were determined during the period of maximum zooplankton abundance prior to and after the establishment of zebra mussel colonies. Zooplankton community composition was the same in both years. Decreased zooplankton numbers and community filtering rates indicated that grazing by zooplankton was likely not responsible for noted declines in phytoplankton abundance and productivity.

Bridgeman, T.B., G.L. Fahnenstiel, G.A. Lang, M.J. McCormick, and T.F. Nalepa. 1995. Phytoplankton productivity in Saginaw Bay, Lake Huron: Effects of zebra mussel (*Dreissena polymorpha*) colonization. *Journal of Great Lakes Research* 21(4):465-475 (1995).
<http://www.glerl.noaa.gov/pubs/fulltext/1995/19950010.pdf>

This study found a significant increase in light to the benthic (bottom) region and contributed to increased benthic primary productivity. Overall, primary productivity in the inner region of Saginaw Bay did not exhibit a notable change after zebra mussel colonization as decreases in phytoplankton productivity were accompanied by increases in benthic primary productivity. Thus, zebra mussels altered inner Saginaw Bay from a pelagic-dominated system to a benthic/pelagic (open water) system, which will have long-term effects on food web structure and productivity at higher trophic levels.

Loss of Fish and Wildlife Habitat Degradation of Fish and Wildlife Populations

Significance in the Saginaw River/Bay Area of Concern

According to the 1995 RAP, significant habitat loss and degradation have occurred in the Saginaw River and Saginaw Bay. Habitat degradation includes the loss of coastal marsh areas, the sedimentation of fish spawning reefs in Saginaw Bay, and numerous impacts from exotic species (e.g. goby, ruffe, and zebra mussels). This habitat loss and degradation has impaired the reproductive success and growth of numerous aquatic and wildlife species (MDNR, 1995).

Restoration Criteria

Per the *Guidance*, these two BUIs are considered together in recognition of the integral relationship between them. The restoration criteria outlined in the *Guidance* is a process for local PACs to use to develop locally-derived restoration targets and plans for fish and wildlife habitat and populations. The Partnership is currently in the process of developing restoration criteria. The finalized restoration plans will be part of future biennial RAP updates, and will contain at least the following components:

- A short narrative on historical fish and wildlife habitat or population issues in the AOC
- Description of the impairment(s) and location for each aquatic habitat or population site(s) to address all habitat or population issues identified in the RAP documents
- A locally derived restoration target for each impacted habitat or population site
- A list of all other ongoing habitat or population planning processes in the AOC

- A scope of work for restoring each impacted aquatic habitat or population site
- A component for reporting on habitat or population restoration implementation action(s) to the MDEQ.

Removal of this BUI will be based on achievement of full implementation of actions in the steps above. Habitat values and populations need not be fully restored prior to delisting, as some may take many years to recover after actions are complete. Actions already implemented in the AOC may be reported and evaluated as long as the documentation contains all of the elements above.

Remedial Actions

Many pollution reduction regulations and programs have been instituted since the designation of the AOC. Some have been aimed at reducing pollution in general across the country. Others have been focused on the Saginaw River/Bay AOC specifically. All have served, directly or indirectly, to improve the water quality conditions in the AOC. The significant source control and remedial actions that have occurred since the 2001 RAP Update are listed above under the Remedial Actions section of the Eutrophication or Undesirable Algae BUI.

Significant progress has been made in conserving and restoring habitat within the Saginaw River/Bay AOC. Numerous local, state, and federal actions have permanently protected and restored large areas of fish and wildlife habitat. In particular, there has been significant private and non-profit investment of time and resources to protect and restore coastal wetland and fish spawning habitat. The following bullets are examples of projects that have been completed or are currently being implemented since the 2004 RAP:

- The Saginaw Bay Watershed Initiative Network (WIN) was established to address sustainable community issues through balancing economic, social, and environmental priorities. Numerous projects have been funded to protect and restore the Saginaw Bay watershed. Below are a few examples of recent projects funded, in part or wholly, through WIN to address fish and wildlife impairments. Information on other WIN projects can be found on WIN website at: www.saginawbaywin.org.
 - Ducks Unlimited (DU) completed a project to map the coastal wetland vegetation along the Saginaw Bay coastline using airborne hyperspectral imagery acquired in 2002 by the U.S. EPA.
 - In 2006, a fish passage study was completed on the Cass River.
 - Between 2005 and 2006, the U.S. FWS obtained funding from the WIN to conduct an evaluation of sturgeon spawning activities in the Tittabawassee, Saginaw, Cass, and Shiawassee Rivers. The objective of the study was to determine whether sturgeon are using the Saginaw River for spawning and determine whether habitat is sufficient for early life history requirements.

- DU restored an 80-acre parcel of land adjacent to the Wigwam Bay State Wildlife Area that had been purchased by MDNR in 2004. This project is not yet complete. DU also received funding from the North American Wetlands Conservation Act (NAWCA), WIN, Bay Area Community Foundation and Dow to restore approximately 135 acres of coastal wetlands at the Wildlife Area.
- DU has accepted and administered three \$1 million NAWCA grants on behalf of a wide diversity of conservation partners to conserve wetlands and associated habitats in the Saginaw Bay Watershed. The Saginaw Bay Wetland Initiative was completed in 2004 and resulted in the conservation of 4,178 acres of habitat. The Saginaw Bay Wetland Initiative (Phase II) was completed in 2006 and resulted in the conservation of 4,125 acres of habitat. In 2005, DU accepted and is currently administering the Saginaw Bay to Lake Erie Coastal Habitat NAWCA grant, which will result in the conservation of more than 3,800 acres of habitat in the coastal zone along Saginaw Bay, Lake St. Clair, the Detroit River and western Lake Erie. A phase II of this proposal was submitted by DU in March 2008.
- A technical committee consisting of DU, MDNR, U.S. FWS, MDEQ and others developed a technical document to guide land manager's through the process of controlling invasive *Phragmites* in Great Lakes coastal wetlands.
- The MDNR and DU enhanced 865 acres of coastal wetland and grassland habitat in the Nayanquing Point State Wildlife Area. This project was partially funded via a small NAWCA grant.
- A partnership between DU and the MDNR, using NAWCA funding, restored 298 acres of Saginaw River floodplain to hemi-marsh wetland and wet meadow at the Crow Island State Game Area, Davis Unit.
- With funding from the General Motors NRDA settlement, the U.S. FWS restored 900 acres of wetland, improving fish passage between Tobico Marsh at the Bay City State Recreation Area and Saginaw Bay.
- The MDNR recently purchased a 44-acre tract associated with Fish Point State Wildlife Area. The acquisition was funded by the Natural Resources Trust Fund and includes 1,377 feet of undeveloped lakeshore frontage comprised of coastal wetlands and sandy upland ridges with mixed hardwood forest. This addition to the State Wildlife Area has secured valuable wildlife habitat from future development and will increase public recreational opportunities in the area.
- The MDNR has been managing *Phragmites*, an invasive wetland plant, at the Bay City State Recreation Area, Nayanquing Point State Wildlife Area, Fish Point State Wildlife Area, Shiawassee River State Game Area, and Quanicassee State Wildlife Areas. Much of this work was completed in partnership with DU, who provided herbicide for the *Phragmites* control at Nayanquing Point, Fish Point and Shiawassee River.
- Beginning in 2007, in response to the growing need to address the rapid spread of *Phragmites* in Saginaw Bay, the MDEQ, DU, MDNR, and Hampton Township implemented a *Phragmites* control demonstration project along selected reaches of *Phragmites* infested public and private owned shorelines. The results of the demonstration project will be used to develop a public

outreach and educational brochure describing treatment options, associated state permit requirements, and restoration opportunities.

- From 2002 to 2005, the MDEQ provided Section 309 Coastal Zone Management funding to Michigan State University, Grand Valley State University, and Michigan Natural Features Inventory to characterize and assess coastal wetlands along Saginaw Bay. This research provided the foundation for research into the effects of fragmentation (beach grooming) on the biodiversity of the same coastal wetlands.
- The 2005 year class of walleye now appears to be even stronger than the previous two classes, which suggests that the population and fishery will continue to grow. Growth rates of walleye have reached target levels, one of the indicators of expanding abundance in the MDNR's Walleye Recovery Plan for Saginaw Bay. No walleye stocking is planned for 2007, in part, because of the continued good natural reproduction.
- Environmental objectives have been developed for Lake Huron, of which specific objectives are mentioned for Saginaw Bay to describe the biological, chemical and physical needs of these desired fish communities.
- In an effort to preserve high priority wetland habitats, a Saginaw Bay High Quality Wetland Protection Technical Work Group has been formed, through the SBCI, to identify wetlands that are critical to Saginaw Bay and inform local authorities of the various methods that may be used to preserve these areas.
- The Saginaw Bay Greenways Collaborative had completed a green infrastructure plan that identified and connects significant wildlife habitats, threatened natural resources, and opportunities for non-motorized trail network in the Bay, Midland and Saginaw counties. The Collaborative is made up of over two dozen agencies and organizations including local land conservancies, governmental agencies, private individuals and other key stakeholders.
- In October 2003, the Partnership hired PSC to conduct an assessment and develop information for communities and resource managers to help identify the most cost-effective options for enhancing fish passage over barrier dams to achieve the targeted, sustainable fish population goals for Saginaw Bay. According to MDNR, providing the ability to move fish past the City of Frankenmuth dam on the Cass River, the Chesaning dam on the Shiawassee River, the Dow dam on the Tittabawassee River represents one of the most significant opportunities to help reestablish and sustain desirable fish populations in the Saginaw Bay watershed.
- The Marsh Monitoring Program, a binational marsh bird and amphibian population monitoring initiative, is providing information about the long-term health and ecological integrity of coastal and inland wetlands located in the Saginaw River/Bay AOC. In the spring and summer months of 2007, training of volunteers and monitoring occurred. The 2008 field season is currently being planned.
- A 140-acre piece of shoreline property along Wildfowl Bay in Huron County is being sold to the Saginaw Basin Land Conservancy. The land is being acquired by a \$930,000 grant from the National Coastal Wetlands

Conservation grant program. Additional funding is coming from the Michigan Chapter of the Nature Conservancy and DU. This land acquisition is located near several state-owned and protected lands located along Wildfowl Bay.

- In January 2008, the National Oceanic and Atmospheric Administration awarded a regional consortium of Great Lakes area universities and research organizations \$760,000 for the first year of a five-year, \$3.8 million pilot project to develop a new approach to analyzing and managing the cumulative effects of climate change, land use, invasive species, and other environmental stressors on Saginaw Bay and its surrounding ecosystem.

Assessment Activities and Results

This beneficial use is currently impaired. A technical committee will be convened when the MDEQ and the Partnership determine that this BUI is ready for a formal review and assessment. The technical committee will review the results of all remedial actions completed and other supporting documentation to provide a decision on whether or not to support a recommendation to formally remove this BUI.

Annotated References and Studies

Ducks Unlimited. 2000. Saginaw Bay Watershed Program Area: Strategic Plan, October 10, 2000.

The plan outlines conservation strategies that DU will use to protect and restore habitat for waterfowl and wildlife, improve waterfowl production, improve water quality, and educate the public on the benefits of habitat conservation in the Saginaw Bay watershed.

Fielder, D. and J. Baker. 2004. Strategy and options for completing the recovery of walleye in Saginaw Bay, Lake Huron. Michigan Department of Natural Resources, Fisheries Special Report 29.

The report outlines an adaptive management strategy and options to restore walleye populations in Saginaw Bay.

Liskauskas, A., J. Johnson, M., McKay, T. Gorenflo, A. Woldt, and J. Bredin. 2004. Draft environmental objectives for Lake Huron: draft report of the environmental objectives working group of the Lake Huron technical committee.

The Lake Huron Environmental Objects were developed to describe the biological, chemical and physical needs of the desired fish communities.

Nelson, C. 2000. Saginaw Bay Watershed Wildlife Habitat Conservation Framework. Watershed Initiative Network Wildlife Stewardship Task Group.

The Wildlife Stewardship Task Group of WIN has identified habitat conservation as a primary focus for its work to meet the vision of WIN. One key component of this effort was to develop a watershed wildlife habitat conservation framework to facilitate efficiency, effectiveness and coordination.

PSC. 2005. Enhancing Fish Passage Over Low-head Barrier Dams in the Saginaw Bay Watershed.

This report provides an assessment and outlines information that communities and resource managers can use to identify the most cost-effective options for enhancing fish passage over barrier dams to achieve the targeted, sustainable fish population goals for Saginaw Bay.

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